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EPA'S RESEARCH AND DEVELOPMENT PROGRAM FOR WASTE MINIMIZATION

by

James S. Bridges
Chief, Products and Assessments Section
Waste Minimization Branch
Risk Reduction Engineering Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
26 W. Martin Luther King Drive
Cincinnati, Ohio 45268

RISK REDUCTION ENGINEERING LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

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16. ABSTRACT

This paper was presented at the 7th Annual Virginia Waste Management Conference in Richmond, Virginia on April 26, 1989. The purpose of the presentation and paper was to discuss the results of two cooperative agreements describing a non-traditional approach to pollution prevention based on research, technology transfer, and education; and to discuss current pollution prevention research progress of EPA's pollution prevention research program. The cooperative agreement with federal, state and trade association pollution prevention research approach emphasizes a non-regulatory means of encouraging industry to use innovative technologies and management practices that can both reduce pollution and provide economic benefits. This approach is evident in the discussion of current pollution prevention research programs progress.

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While coolant maintenance schemes have long been proposed by coolant suppliers as a means to extend coolant life, they have usually been ignored in favor of the simpler "use-and-dump" routine. However, as regulatory pressures and prices ($20-200 per 55-gallon drum for treatment) have increased, machine shops have begun to practice coolant maintenance with an excellent potential to extend coolant life and thereby reduce the volume of coolant waste generated. This study, conducted by Washington Scientific Industries, Inc., (WSI), Long Lake, Minnesota, examined factors and techniques which contribute to coolant life extension.

WSI is a machine shop which uses a wide variety of tools to make parts from materials such as steel, aluminum, and copper. The machines used at WSI are medium-sized and are similar to those used in many machine shops. Machine tools chosen for monitoring during the study are one to four years old, used for jobs with long (2-4 week) production runs. Operators, materials, and processes were held constant during monitoring as much as possible. After sampling to establish baselines for parameters such as water quality, coolant quality, and health effects, the study focused on the effects on coolant life of coolant change practice, coolant maintenance, and coolant type.

Using standard industrial engineering techniques, the following procedure was established as the method of removing and replacing contaminated coolant which may extend coolant life.

1. Skim all way-oil from coolant surface
2. Pump coolant from sump
3. Vacuum chips from sump
4. Remove sump access covers
5. Steam clean and vacuum sump (repeat until clear)
6. Replace sump access covers and coolant

What distinguishes this method from standard industrial practice is the complete removal of the coolant and the thorough cleaning of the sump itself, both of which are believed to remove bacterial contamination, thereby slowing degradation of the coolant.

The coolant maintenance practice which showed the most promise was skimming accumulated way oils from the surface of the coolant, thus increasing aerobic activity. Both belt- and disc- type skimmers were evaluated and found to be effective in reducing oil and grease concentrations. As part of this evaluation, it was also discovered that many standard machine tool coolant sumps do not allow access for installation of a skimmer, which means that a capital expenditure for sump modification is often required. This may be a partial explanation of why this simple, inexpensive (less than $100) technique is not more widely used.

A specific water-soluble coolant (Blasocut 2000 Universal) was evaluated on its performance when recycled over long periods of time. It is thought that using one coolant in as many applications as possible will simplify the entire waste management scheme and allow the most efficient coolant maintenance. Blasocut 2000, even after being recycled for seven months, met or exceeded metal removal rates (a standard measure of coolant performance) for aluminum, steel, copper and stainless steel. The use of recycled coolant also does not appear to have any adverse health effects on operators, a problem which has occurred with some coolants in the form of dermatitis.

The results of this study indicate that it is possible to extend the life of machine tool coolant significantly and thereby reduce the volume of waste coolant generated. The changes documented, taken together, resulted in an extension of coolant life from an original life of one to two weeks to eleven months.

Current Pollution Prevention Research Program

In the summer of 1988, EPA's Office of Research and Development began to emphasize the pollution prevention research needs and considered strategies that defined the most efficient and cost-effective approaches to reducing environmental risk in the future. The Office of Environmental Engineering and Technology Demonstration approved a plan to consolidate the Water Engineering Research Laboratory and the Hazardous Waste Engineering Research Laboratory in Cincinnati, Ohio. The newly formed Risk Reduction Engineering Laboratory (RREL) combined skills and talents to address multi-media research problems. Within RREL, the Waste Minimization Branch (WMB) was established to conduct waste minimization research and is a primary contact within the Agency for pollution prevention research efforts concentrating on source reduction and recycling (Figure 1).

The WMB has organized its research activities into four major programs described below. Through these programs, the Branch identifies and evaluates relevant production operations and waste management practices, demonstrates waste reduction techniques and technologies, designs and tests prototypes of waste management systems, performs model waste minimization assessments for public and private pollution prevention operations, and participates in a variety of technology transfer activities. The WMB also provides technical support to other EPA Offices, industry, State and local governments and other Federal agencies.

WASTE MINIMIZATION RESEARCH PROGRAMS

Waste Reduction Innovative Technology Evaluation (WRITE)
Waste Reduction Evaluations at Federal Sites (WREAFS)
Waste Reduction Assessments Program (WRAP)
Pollution Prevention Information Clearinghouse (PPIC)

NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

EPA'S RESEARCH AND DEVELOPMENT PROGRAM FOR WASTE MINIMIZATION

INTRODUCTION

There has been a great deal of progress in the areas of pollution prevention and small waste generator research since my paper was presented at the "Fifth Annual Virginia Hazardous Waste Management Conference" in April, 1987. A review of the 1987 paper was a starting point in preparing this paper and provided an opportunity to step back and evaluate the progress of EPA's Pollution Prevention Research Program. It is evident today that the focus of our former small waste generator research program was pollution prevention and the avenue of practicality for future small to medium-sized waste generator research is pollution prevention techniques and technologies. In the developing days of the current research program in pollution prevention, established in July, 1988 with the Waste Minimization Branch as part of the Risk Reduction Engineering Laboratory, EPA's contributions included the results from three cooperative agreements with the State of North Carolina, the State of Minnesota, and the Governmental Refuse, Collection and Disposal Association, several waste minimization audit reports, and the development of the EPA's "Waste Minimization Opportunity Assessment Manual."

In the spring of 1986, two cooperative agreements were established by EPA's Small Waste Generator Research Program with the Minnesota Technical Assistance Program (MnTAP), and the Governmental Refuse, Collection and Disposal Association (GRCDA). The purpose of these cooperative efforts was to design and implement a research program within the State of Minnesota that would provide small and medium-sized hazardous waste generators with new techniques and technologies for waste minimization, and to transfer the research results to the industries and states through an active waste management trade association. EPA continues to stand behind the principle of waste minimization or pollution prevention as the best solution to the unique waste management problems of small and medium-sized waste generators. Results from this research program to date have provided many practical, economical and sound engineering solutions to assist waste generators. These cooperative agreements formed a solid foundation for building the current research program.

This paper describes the results of the MnTAP and GRCDA Cooperative Agreements, the current EPA Pollution Prevention Research Program, and discusses research plans for the future.

GRCDA/EPA COOPERATIVE AGREEMENT

Technology Transfer Through GRCDA Clearinghouse

To meet the technology transfer and information needs of hazardous waste generators, the EPA established a cooperative agreement with the Governmental Refuse Collection and Disposal Association (GRCDA) to develop an Information and Technical Assistance Clearinghouse in March, 1986.

The GRCDA is an association of waste management professionals dedicated to promoting environmental compliance by providing technical information and education to those who wish to better the waste management industry. One of the objectives of the GRCDA/EPA cooperative agreement was to provide for a national technical information transfer of waste minimization research such as the research conducted under the MNTAP/EPA cooperative agreement. It was determined that trade associations are generally responsive to the needs of their members and will work with other trade associations to meet these needs.

Under the Clearinghouse, a number of services were established to foster an information exchange and transfer of waste minimization/waste management technology information. The services provided to achieve these goals include:

1. A Toll-Free Hotline

   The Clearinghouse Hotline (1-800-456-4723) puts the caller in direct contact with GRCDA staff who can provide immediate technical assistance. This includes information on proper waste management practices, waste minimization technologies and current regulatory program developments.

2. Technical Referral Service

   The Clearinghouse, as a national focal point for waste management information, developed a network of state, regional and technology specific programs throughout the United States. This made it possible for GRCDA staff to link together information requests with the best sources.

3. Clearinghouse Library

   The Clearinghouse Library is a compilation of publications produced by the public and private sector on waste management issues. Most often these resource materials are photocopied by the staff and sent out upon request or to supplement an assistance effort. For copywrite materials, ordering information through the publisher is provided. Reports from other aspects of the U.S. EPA waste minimization research program are also contained here for distribution.

During the thirty-six months the Clearinghouse has been in operation, technical assistance has been directly provided to approximately 500 businesses and others involved in waste management issues. GRCDA staff have also made presentations at conferences, contributed to publications and periodicals, and worked with related trade associations and assistance programs.

The funding for the Clearinghouse ended on September 30, 1988. GRCDA continues to operate the Clearinghouse by charging for photocopying, shipping, and handling of publications. The hotline number is still available for technical assistance. The GRCDA staff now publishes "HAZ-X-CHANGE," a

The funding for the Clearinghouse ended on September 30, 1988. GRCDA continues to operate the Clearinghouse by charging for photocopying, shipping, and handling of publications. The hotline number is still available for technical assistance. The GRCDA staff now publishes "HAZ-X-CHANGE," a newsletter to strengthen the network of programs with consistent contact to the generator. "HAZ-X-CHANGE" was first sent out free of charge in the late summer of 1988 to 400 regulatory and non-regulatory federal, state and local agencies, technical assistance programs, trade associations, research facilities and waste exchanges.

MNTAP/EPA COOPERATIVE AGREEMENT

The MnTAP/EPA cooperative agreement consisted of nine research projects focused on the special needs of small to medium-size Minnesota waste generators, but have application to waste generators across the country. The primary objective of the MnTAP program is to provide technical assistance to small quantity generators who want to reduce the generation of hazardous waste. Results from each of these nine research projects are in report form and available upon request fron the MnTAP. The nine projects are:

1. Chromic Acid Waste Treatment/Recycling/Disposal
2. Microscaling Instructional Laboratory Experiments
3. Biological Degradation of Cyanide by Nitrogen-fixing Cyanobacteria
4. Recovery of Metals from Metal Finishing Waste Streams using Aluminum Displacement
5. Metal Removal/Recovery from Radiator Repair Shop Cleaning Solutions
6. Removal of Oil from Oil-water Mixtures using Selective Oil Filtration
7. Reduction of Machine Tool Coolant Waste by Optimizing Coolant Life
8. Pesticide Rinsate Recycle Facilities
9. Removal of Solvents from Wastewater by Ultraviolet Photo-oxidation

Each of the nine research projects included fifty percent non-EPA matching funds and averaged about $15,000 per project. The innovative thinking within academia and industry is exemplified through these projects using applied technology and few resources. The project that perhaps best typifies the innovativeness and dedication of the small waste generator is the project that extends the life of machine tool coolant thereby reducing the amount of waste being generated. The project is described as follows:

Reduction of Machine Tool Coolant Waste by Optimizing Coolant Life

Machine shops use coolants, frequently oils emulsified in water, to improve the life and function of machine tools such as drills, lathes and broaches. Coolants are allowed to flow in a continuous stream over the tool and the material being machined, carrying away excess heat generated by friction. The coolant is collected and recirculated and, over time, becomes contaminated with metal chips and "way oil" (lubricant). These contaminants create favorable conditions for the growth of anaerobic bacteria, which produce hydrogen sulfide gas, shorten coolant life, and eventually force disposal of the coolant as waste. The exact waste management scheme for this waste coolant is determined by the type of coolant, contaminants (metals, organic solvents, biocides, nitrates), and availability of treatment. Standard practice is often to drain waste coolant to the sanitary sewer after surface skimming of accumulated oils.

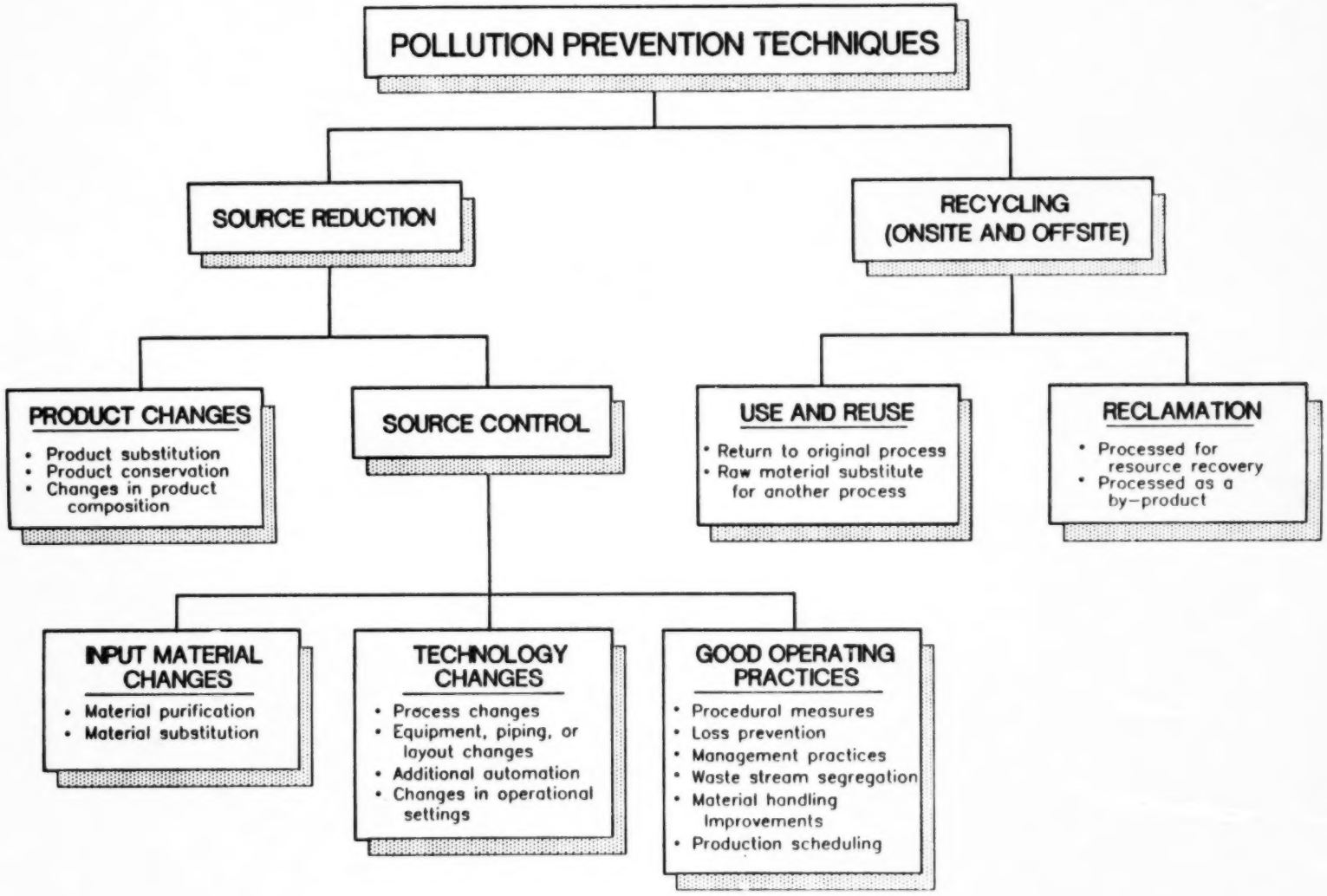

Figure 1. Waste Reduction Techniques

WRITE Program

The Waste Reduction Innovative Technology Evaluation (WRITE) Program is primarily a research demonstration program designed to evaluate the use of innovative engineering and scientific technologies to reduce the volume of waste produced and the toxicity of wastes generated from the manufacture, processing, and use of materials. The overall goal of the WRITE Progam is to promote a national pollution prevention policy by forming research partnerships with EPA, industry, state and local governments and academia in an effort to encourage the development and/or demonstration of effective technologies for waste reduction.

The WRITE Pilot Program, with state and local governments, addresses immediate information transfer needs between government and industry. Through the joint efforts of EPA and various state and local governments, technical and economic evaluations of source reduction and recycling technologies are being conducted of manufacturing and processing operations across approximately twenty industries. States participating in this program include California, Connecticut, Illinois, Minnesota, New Jersey and Washington. The WRITE Program, with industry, focuses on evaluations of waste reduction technologies currently in use or under development by large industries. Under this program, evaluations of waste reduction technologies are performed directly with industrial firms or through industrial trade associations and/or technical societies. The WRITE Research Program focuses on pollution prevention research needs and addresses various technical obstacles to waste reduction, and to chemical or waste-stream, and industry-specific waste minimization issues and are industrial firms, universities, other government agencies, technical societies, and industrial trade organizations (Figure 2).

The WRITE Program is the cornerstone of the research programs within the WMB with a great potential to transfer pollution prevention information regarding various technologies across diverse industries through the States. Each of the other waste minimization research programs will benefit from the knowledge gathered by the WRITE Program. Early in fiscal year 1989, a guidance document for the WRITE Pilot Program with state and local governments was prepared to describe the WRITE Program and establish an operational approach to conduct pollution prevention research. Cooperative agreements are being negotiated to carry out the objectives of the Program.

The objectives of the WRITE Program are as follows:

- To establish reliable performance and cost information on pollution prevention techniques by conducting evaluations on demonstrations of the more promising innovative technologies.

- To accomplish an early introduction of water-reduction techniques into broad commercial practice.

- To encourage active participation of small and medium-sized companies in evaluting and adopting pollution prevention concepts by providing support to these companies through state and local government agencies.

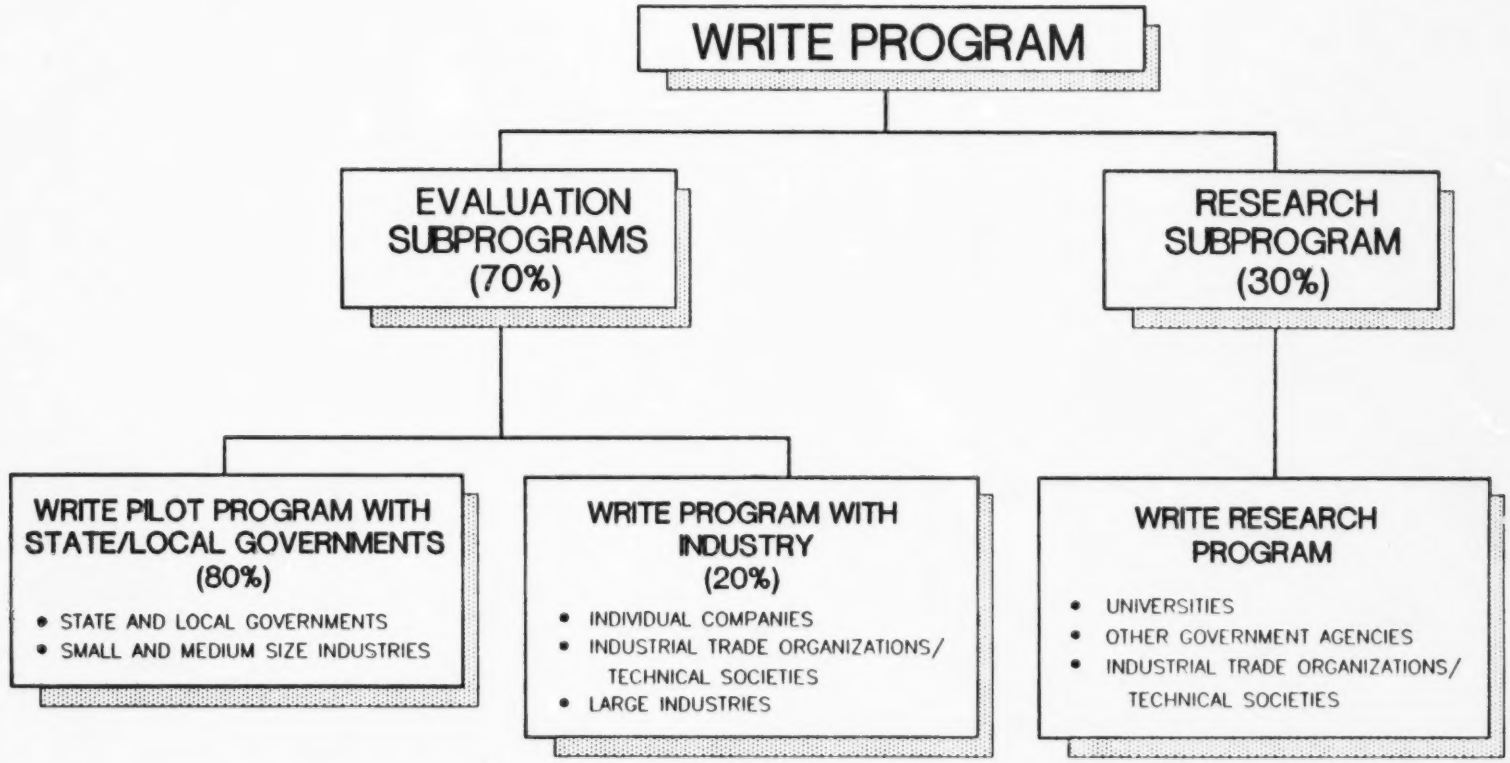
WRITE PROGRAM
EVALUATION SUBPROGRAMS (70%)
RESEARCH SUBPROGRAM (30%)
WRITE PILOT PROGRAM WITH STATE/LOCAL GOVERNMENTS (80%)
• STATE AND LOCAL GOVERNMENTS
• SMALL AND MEDIUM SIZE INDUSTRIES
WRITE PROGRAM WITH INDUSTRY (20%)
• INDIVIDUAL COMPANIES
• INDUSTRIAL TRADE ORGANIZATIONS/ TECHNICAL SOCIETIES
• LARGE INDUSTRIES
WRITE RESEARCH PROGRAM
• UNIVERSITIES
• OTHER GOVERNMENT AGENCIES
• INDUSTRIAL TRADE ORGANIZATIONS/ TECHNICAL SOCIETIES

Figure 2. Subprogram Emphasis in the WRITE Program

- To encourage the transfer of knowledge and technology concerning pollution prevention practices among large, medium-sized and small industries.

- To provide solutions to important chemicals, waste streams, and industry-specific pollution prevention research needs.

WREAFS Program

The Waste Reduction Evaluations at Federal Sites (WREAFS) Program consists of a series of demonstration and evaluation projects for waste reduction conducted cooperatively by EPA and various parts of the Department of Defense (DOD), Department of Energy (DOE), and other Federal agencies. The WREAFS Program focuses on waste minimization research opportunities and technical information transfer at Federal sites.

Many federal activities have established waste reduction plans and programs in the past few years. For example, an overall goal within DOD is to reduce hazardous waste generation a total of fifty percent by 1992 compared to 1985. There are several operation and process opportunities for pollution prevention practices at Federal sites which will reduce hazardous and other wastes, and result in providing cost avoidance or cost reduction as well as productivity, environmental, and human health benefits. Waste minimization opportunities can be applied throughout the Federal community in fabrication, production and/or maintenance processes depending on the waste generating function. Industrial activities which support federal activities through in-house or contract efforts whether on or off-site are generally the same activities within the private sector. The application may vary depending on the final product; however, waste reduction techniques and technologies should work in both the federal or private sector. The WREAFS Program encourages the use of any unclassified federal and industrial pollution prevention information to the maximum extent practicable.

The objectives of the WREAFS Program include the following:

* Conduct waste minimization workshops
* Perform waste minimization opportunity assessments
* Develop technical information transfer opportunities between industry and government
* Provide EPA developed research information to Federal facilities
* Demonstrate waste minimization techniques or technologies at Federal facilities
* Promote and enhance waste minimization benefits within the federal community

As a result of a November 1988, WREAFS meeting in Washington, D.C. with representatives from the Department of Defense, Veterans Administration and the Environmental Protection Agency, candidate sites were solicited from Federal activities to conduct waste minimization opportunity assessments. Six assessments are planned for in fiscal year 1989 with each branch of the

military offering a candidate site along with other agencies. The WREAFS Program anticipates active participation from within the federal community and will provide the catalyst for technology transfer through EPA's various programs. Assessments are being conducted at the Cincinnati Veteran's Hospital and the Andrew W. Breidenbach Environmental Research Center.

WRAP Program

The Waste Reduction Assessments Program (WRAP) is a series of waste minimization assessment projects designed to encourage waste generators to utilize a systematic planned procedure with the objective of identifying options to reduce or eliminate waste. The foundation for the WMB assessment program is the "Waste Minimization Opportunity Assessment Manual" which was produced in July of 1988. This manual has become a model for many industry-specific assessment manuals. Several assessment projects are being conducted through cooperative agreements with the California Department of Health, University City Science Center, and the New Jersey Department of Environmental Protection.

Through the California Department of Health, EPA is developing nine industry-specific waste minimization manuals. These manuals will be available for distribution by late summer of 1989. The industries included are:

* Paint Manufacturing
* Hospitals
* Pesticide Formulators
* Research Laboratories
* Commercial Printers
* Photographic Processing Laboratories
* Metal Fabricators
* Fiberglass Manufacturing
* Printed Circuit Board Manufacturers

Secondly, the California Department of Health is conducting a project to determine the potential for reducing halogenated organic wastes. This study will be completed in late 1989 and will provide results and recommendations regarding halogenated organic waste streams in Los Angeles.

The University City Science Center is utilizing the expertise of engineering schools to conduct waste minimization assessments for small waste generators. Currently, programs exist at Colorado State University and the University of Tennessee. A third engineering school is anticipated within the next few months with each school funded for a three-year period.

Other waste minimization assessments include an ongoing cooperative agreement with the New Jersey Department of Environmental Protection to support thirty demonstration assessments in ten different industries within New Jersey.

PPIC Program

EPA's Office of Pollution Prevention and Office of Research and Development are jointly developing the Pollution Prevention Information Clearinghouse. EPA's October 1986 Report to Congress on Minimization of Hazardous Wastes expresses the need for EPA to provide assistance to generators through the States, to provide technical support of research and development, and to develop a computerized information system on waste minimization, accessible by the States. There is no doubt that the lack of readily-available information regarding the application of technologies and techniques along with the demonstration of economic benefits of waste minimization is holding back pollution prevention progress. There appears to be universal support to EPA's establishment of the PPIC.

In December 1988, a PPIC Workshop was conducted in Cincinnati, Ohio to develop one or more options for a maximally useful and cost-effective information clearinghouse on waste minimization. The workshop participants endorsed five mechanisms for use by the Clearinghouse. These mechanisms are: 1) establishment of a commonly-accepted accession/indexing technique for clearinghouse holdings; 2) incorporation of a hotline: 3) publication of a user's bulletin; 4) assurance of a hard copy report available to users and; 5) incorporation of an Electronic Information Exchange capability.

The workshop recommended ten products or services for provision by the Clearinghouse. While the amount of funding will dictate what can actually be accomplished in 1989, it was determined that these ten items would be highly desirable. A steering committee from the workshop attendees are continuing to work together during the formulation of final plans for EPA's PPIC. The ten products or services are:

* Indexed bibliographies of reports, etc.,
* Indexed abstracts of reports, publications, etc.,
* Indexed case studies of demonstrations/evaluations
* Lists of contacts (states, EPA, trade associations, etc.)
* Calendar of conferences, seminars, events
* Information on Federal activities/legislation
* Information on State activities/legislation
* Electronic bulletin board
* Lists of on-going projects (demos, evaluations, R&D, etc.)
* User statistics/profile

The first year of the Clearinghouse will be devoted to assuring mechanisms work, defining the products and services, and building a technical information data base.

SUMMARY

Progress is moving swiftly for pollution prevention research as industry and government are working together in a non-regulatory approach for providing solutions to reducing or eliminating the generation of wastes. Innovative technologies and management practices are reducing pollution and enhancing economic benefits.

The establishment of the Waste Minimization Branch within the Office of Research and Development provides the Agency with a focal point for the technical support of research programs related to pollution prevention efforts. The pollution prevention evaluation and demonstration efforts described in this document address issues concerned with process engineering, clean products and technologies, and recycling. The WRITE, WRAP, and WREAFS Programs require the integration of technology and information transfer for greater support and technical assistance to other offices within EPA, other Federal agencies, State and local governments and industry. These programs will expand as necessary to meet the needs expressed in the "Municipal Solid Waste Research Agenda for the Nation" and the "Pollution Prevention Research Plan Report to Congress." Pollution prevention research conducted within the WMB is concerned with source reduction and recycling and the concept of pollution prevention is applied to all media pollution, defined as hazardous and non-hazardous.

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